25. (Newly Added) The waveguide of claim 24, wherein the third conductive channel is generally C-shaped.

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26. (Newly Added) The waveguide of claim 24, wherein the third conductive channel is generally I-shaped.

27. (Newly Added) The waveguide of claim 24, wherein the third conductive channel comprises a bent sheet of electrically conductive material.

28. (Newly Added) The backplane system of claim 17, wherein the gap has a gap width that allows propagation of the electromagnetic waves within the first and second conductive channels.

REMARKS

During a telephone conversation with the undersigned attorney, the Examiner required restriction to one of the following groups of claims: I) claims 1-6 or II) claims 7-15. Applicant affirms the election to restrict prosecution of the application to claims 1-6, without traverse. Accordingly, Applicant has hereby canceled claims 7-15 from this application, without prejudice as to the patentability of those claims.

The disclosure is objected to because of certain informalities. Applicant respectfully requests that the objections to the disclosure be withdrawn in view of the foregoing amendments.

After entry of the foregoing amendments, claims 1-5 and 16-28 will be

pending in the application. Claim 1 is an independent claim. Claims 2-5 and 16-28 depend ultimately from claim 1. Claim 1, as amended herein, includes all the limitations of claim 6 as originally submitted. Applicant respectfully submits, therefore, that the rejections of claims 1-5 as originally submitted are moot in view of the foregoing amendment. Claim 6 as originally submitted is rejected under 35 U.S.C. § 102(e) as being anticipated by Ishikawa.

As the Examiner recognizes, the waveguide of Ishikawa includes a region (23c) in which electromagnetic waves propagate through the waveguide (23), and adjacent regions (23a, 23b) in which electromagnetic waves do not propagate. The regions (23a and 23b), wherein the waves do not propagate, are formed between respective opposing electrode pairs (21a/22a and 21b/22b). Slots (24 and 25) are formed between respective adjacent electrode pairs (21a/21b and 22a/22b). Thus, the slots (24, 25) define the width of the propagation region (23c).

Applicant respectfully submits, therefore, that the slots (24, 25) of Ishikawa are not analogous to the "gap" of the claimed invention, which prevents propagation of a lower order mode *into* a higher order mode. The gap of the claimed waveguide is a small-scale gap that controls current flow through the conductive channels and, therefore, prevents propagation from lower order modes *into* higher order modes. To the contrary, the slots of Iskikawa are large-scale gaps that enforce the mode structure of the waveguide. Applicant respectfully submits, therefore, that Ishikawa does not teach or suggest providing slots (24, 25) to prevent propagation of one mode *into* another. Accordingly, Applicant respectfully submits that claim 1 patentably defines over the teachings of Ishikawa. As claims 2-5 and 16-28 depend ultimately from claim 1, Applicant respectfully submits that those claims patentably define over the teachings of Ishikawa as well.

With particular regard to newly added claim 17, Applicant respectfully submits that Ishikawa neither teaches nor suggests a gap having a gap width, as claimed, that allows propagation along the waveguide axis of electromagnetic waves in a TE n,0 mode, wherein n is an odd number, but suppresses electromagnetic waves in a TE m,0 mode, wherein m is an even number. For this reason as well, Applicant respectfully submits that claim 17 patentably defines over the teachings of Ishikawa.

With particular regard to newly added claim 28, Applicant respectfully submits that Ishikawa neither teaches nor suggests a gap having a gap width that allows propagation of the electromagnetic waves within the conductive channels. To the contrary, the electrodes of Ishikawa are designed to *prevent* propagation in the regions between opposing electrodes. Thus, Ishikawa actually teaches away from a gap, formed between conductive channels, that has a gap width that allows propagation within the conductive channels. Consequently, one skilled in the art would not have been motivated to modify the waveguide of Ishikawa to include a gap having a gap width that would allow propagation other than in the gap region itself. For this reason as well, Applicant respectfully submits that claim 28 patentably defines over the teachings of Ishikawa.

CONCLUSION

In view of the foregoing amendments and remarks, Applicant respectfully submits that the present application is in condition for allowance. Reconsideration of the application and an early Notice of Allowance are respectfully requested. In the event that the Examiner believes that the present application is not allowable for any reason, the Examiner

is encouraged to contact the undersigned attorney to discuss resolution of any remaining issues.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In The Specification

Please replace the paragraph beginning at page 6, line 21, with the following rewritten paragraph:

"SPEEDBOARD," which is manufactured and distributed by Gore, is an example of a low loss, <u>fluorinated polycarbon (*e.g.*, "TEFLON")</u> ["TEFLON"] laminate. Figure 1 shows a plot of the bandwidth per channel for a 0.75m "SPEEDBOARD" backplane as a function of data channel pitch. As the data channel pitch, p, decreases, the channel bandwidth also decreases due to increasing conductor losses relative to the dielectric losses. For a highly parallel (*i.e.*, small data channel pitch) backplane, it is desirable that the density of the parallel channels increase faster than the corresponding drop in channel bandwidth. Consequently, the bandwidth density per channel layer, BW/p, is of primary concern. It is also desirable that the total system bandwidth increase as the density of the parallel channels increases. Figure 2 shows a plot of bandwidth density vs. data channel pitch for a 0.75m "SPEEDBOARD" backplane. It can be seen from Figure 2, however, that the bandwidth-density reaches a maximum at a channel pitch of approximately 1.2 mm. Any change in channel pitch beyond this maximum results in a decrease in bandwidth density and, consequently, a decrease in system performance. The maximum in bandwidth density occurs when the conductor and dielectric losses are approximately equal.--

Please replace the paragraph beginning at page 7, line 10, with the following rewritten paragraph:

--The backplane connector performance can be characterized in terms of the bandwidth vs. bandwidth-density plane, or "phase plane" representation. Plots of bandwidth vs. bandwidth density/layer for a 0.5m glass reinforced epoxy resin (*e.g.*, "FR-4") [FR-4] backplane, and for 1.0m and 0.75m "SPEEDBOARD" backplanes are shown in Figure 3, where channel pitch is the independent variable. [FR-4 is another well-known PCB material, which is a glass reinforced epoxy resin.] It is evident that, for a given bandwidth density, there are two possible solutions for channel bandwidth, *i.e.*, a dense low bandwidth "parallel" solution, and a high bandwidth "serial" solution. The limits on bandwidth-density for even high performance PCBs should be clear to those of skill in the art.--

Please replace the paragraphs beginning at page 11, line 6, and page 11, line 15, with the following rewritten paragraphs:

-- Figures 10-12 also demonstrate the improvement that the present invention can have over conventional systems. Figure 10 provides a graph of attenuation versus frequency for a typical prior art waveguide. As the frequency of the wave propagating through the waveguide increases from about 40 Ghz, the attenuation remains relatively constant at -5 dB, more or less, until the frequency reaches about 80-85 Ghz. At that point, the attenuation increases dramatically to about -30 dB. This sudden increase in attenuation occurs because, at about 80-85 Ghz, the mode of the wave changes. As frequency continues to increase beyond the 80-85 Ghz range (*i.e.*, after the mode changes), the attenuation of the wave returns to normal. Thus, in a prior art waveguide system, a dramatic increase in attenuation of the wave can be observed at the point where the mode changes.

Figures 11 and 12 provide graphs of attenuation versus frequency for a typical backplane system according to the invention wherein the waveguide has a gap such as described above for preventing propagation of a lower order mode into a higher order mode. The graph of Figure 11 represents propagation of the wave in a first direction through the waveguide. The graph of Figure 12 represents propagation of the wave in the opposite direction through the waveguide. As shown in both Figures 11 and 12, the attenuation of the wave is relatively constant, at about 0dB, in the range of frequencies from about 6 Ghz to about 20 Ghz. Thus, Figures 10-12 demonstrate that the waveguides of the present invention provide greater relative bandwidth than conventional systems.-- [Figure 10 provides the attenuation versus frequency characteristics of conventional laminated waveguides using various materials. Figure 11 provides the attenuation versus frequency characteristics of a backplane system according to the present invention, specifically a 0.312" by 0.857" slotted waveguide using a 0.094" diameter copper tubing probe with 5h/8 penetration at λ_0/0.4 GHz. Figure 12 provides the attenuation versus frequency characteristics of another backplane system according to the present invention, this time using a doorknob-type antenna.

These figures demonstrate that the waveguides of the present invention have greater relative bandwidth than conventional systems.]

Please replace the paragraphs beginning at page 12, line 2, and page 12, line 12, with the following rewritten paragraphs:

-- Waveguide 20 can support both an even and an odd longitudinal magnetic mode (relative to the symmetry of the magnetic field in the direction of propagation). The even mode has a cutoff frequency, while the odd mode does not. The field patterns in

waveguide 20 for the desired odd mode are shown in Figure 13B. The fields in dielectric channel 22 (*i.e.*, the region between -a/2 and a/2 as shown in Figure 13B and designated "dielectric") are similar to those of the TE 1,0 mode in rectangular waveguide 10 described above, and vary as Ey ~ cos(kx) and Hz ~ sin(kx). Outside of dielectric channel 22, however, in the regions designated "air," the fields decay exponentially with x, *i.e.*, exp(-τx), because of the reactive loading of the air spaces on the left and right faces 22L, 22R (see Figure 13A) of dielectric channel 22.

The dispersion characteristic of this mode for a "TEFLON" guide is shown in Figure 14, where Beta and F are the normalized propagation constant and normalized frequency, respectively. That is,

$$\text{Beta} = a\beta/2 \qquad (9)$$

and

$$F = (a\omega/2c)(Dr-1)^{0.5}, \qquad (10)$$

where c is the speed of light, and Dr is the relative dielectric constant of dielectric channel 22. The range of operation is for values of f between 1 and 2 where there is only moderate dispersion.--

In The Claims

Please cancel claims 6 and 7-15 without prejudice.

Please amend the claims as follows:

1. (Once Amended) A backplane system, comprising:

a substrate;

a waveguide connected to the substrate, the waveguide having a gap therein for preventing propagation of a lower order mode into a higher order mode;

at least one transmitter connected to the waveguide for sending an electrical signal along the waveguide; and

at least one receiver connected to the waveguide for accepting the electrical signal.

5. (Once Amended) The backplane system of claim 1, wherein the waveguide is [one of a non-radiative dielectric and] an air-filled rectangular waveguide.

16. (Newly Added) The backplane system of claim 1, wherein the waveguide is a non-radiative dielectric waveguide.

17. (Newly Added) The backplane system of claim 1, wherein the waveguide comprises:

a first conductive channel disposed along a waveguide axis; and

a second conductive channel disposed generally parallel to and spaced from the first channel to thereby define the gap between the first and second channels along the waveguide axis, wherein the gap has a gap width that allows propagation along the waveguide axis of electromagnetic waves in a TE n,0 mode, wherein n is an odd number, but suppresses electromagnetic waves in a TE m,0 mode, wherein m is an even number.

18. (Newly Added) The waveguide of claim 17, wherein the first conductive channel has a generally I-shaped cross section along the waveguide axis.

19. (Newly Added) The waveguide of claim 17, wherein the first conductive channel has a generally C-shaped cross section along the waveguide axis.

20. (Newly Added) The waveguide of claim 17, wherein the first conductive channel comprises a bent sheet of electrically conductive material.

21. (Newly Added) The waveguide of claim 17, wherein the second conductive channel is generally C-shaped.

22. (Newly Added) The waveguide of claim 17, wherein the second conductive channel is generally I-shaped.

23. (Newly Added) The waveguide of claim 17, wherein the second conductive channel comprises a bent sheet of electrically conductive material.

24. (Newly Added) The waveguide of claim 17, further comprising:

a third conductive channel disposed generally parallel to and spaced from the first channel to thereby define a second gap between the first and third channels along the waveguide axis, wherein the second gap has a gap width that allows propagation along the

waveguide axis of electromagnetic waves in a TE n,0 mode, wherein n is an odd number, but suppresses electromagnetic waves in a TE m,0 mode, wherein m is an even number.

25. (Newly Added) The waveguide of claim 24, wherein the third conductive channel is generally C-shaped.

26. (Newly Added) The waveguide of claim 24, wherein the third conductive channel is generally I-shaped.

27. (Newly Added) The waveguide of claim 24, wherein the third conductive channel comprises a bent sheet of electrically conductive material.

28. (Newly Added) The backplane system of claim 17, wherein the gap has a gap width that allows propagation of the electromagnetic waves within the first and second conductive channels.